Screening for Diabetic Retinopathy in the 21st Century

In the current issue of *Diabetic Medicine*, the study by P. Bagga and colleagues highlights the continued inadequacy of diabetic retinopathy screening services in the UK, as well as the long waiting times to see an ophthalmologist that are common.[1] This despite data emphasizing the cost effectiveness of providing an adequate screening service in comparison to the cost of blindness[2] and recent data demonstrating new blindness being reduced by one-third following improvement in diabetic care, including better diabetic retinopathy screening.[3] Bagga and colleagues support the provision of adequate funding but also suggest the establishment of 'identical National screening protocols'. Nevertheless there is controversy over what would constitute the optimum screening system and this is highlighted by the fact that the British Diabetic Association has recently produced and circulated two sets of guidelines, one based on retinal cameras[4] and one on community optometrist ophthalmoscopy.[5] The problem with being too proscriptive and introducing identical National protocols (apart from the fact that there is not a consensus on the optimum method) is that by the time any such protocols are introduced, they may well be out of date. Recently published data from our own unit suggested that combining Polaroid retinal photography with ophthalmoscopy is the optimum way of screening for diabetic retinopathy if significant numbers of sight-threatening retinopathy cases are not to be missed.[6,7] We have argued that the addition of Polaroid photography in a situation where screening by dilated ophthalmoscopy is already being undertaken, does not necessarily involve a great increase in cost.[8] Polaroid is advised because the images are instantly available and the patient can be further examined after photography with ophthalmoscopy at the same visit, while the eyes are still dilated. Nevertheless, the Polaroid image is intrinsically of inferior quality to 35 mm film, used in many centres. Furthermore, Polaroid film is relatively expensive. The 35 mm film, though of much higher image quality, has always suffered from not being instantly available. As we move towards the close of the Millenium, retinal imaging systems are becoming available which use digital imaging to capture high quality retinal images which can be viewed on a computer monitor screen. The quality of these images would appear to be comparable to 35 mm film.[9] Yet, like Polaroids, they are instantly available. Our own recently published studies[10] have shown that where Polaroid and electronic images were compared in the same patients, the electronic images were found to be considerably superior in terms of image quality. The superiority in image quality translated into improved sensitivity with regard to diabetic retinopathy detection and categorization. Of 213 eyes from 107 diabetic patients, diabetic retinopathy was present in 58 eyes, of which 55/58 (95 %) were detected on the electronic image and only 49/58 (84 %) on the Polaroid. Of 34 eyes requiring ophthalmologist referral according to standard European criteria, 34/34 (100 %) were detected on the electronic image and only 24/34 (71 %) on the Polaroid.[10]

Compared to the Polaroids, which are relatively expensive (over £1 sterling each), electronic images are effectively 'free'. In view of these factors, many units are already starting to acquire electronic imaging systems and one starts to envisage what screening for diabetic retinopathy might be like in the 21st century. The electronic imaging system could be connected to the main diabetes database, on the hospital computer network, and the electronic images could be stored on the computer database with other data about the diabetic patients, e.g. weight, glycosolated haemoglobin, blood pressure, creatinine. Though the images tend to be collected by the camera systems in large file sizes of the order of one megabyte ('.TIFF' or '.BMP' files), we have demonstrated that the high image quality is preserved with the small '.JPG' image file-type (40 kilobytes) as long as the image is displayed in 16.7 million colours.[11] The '.JPG' file-type is the one used for images on the Internet, and because of its small size it can be transferred rapidly from one computer to another and does not take up much computer storage space. We have also demonstrated that high quality 'hard copy' of the images can be printed out on relatively cheap 'photo-quality' ink jet paper (£0.08 sterling per A4 sheet) by standard 'photo quality' colour ink jet printers (less than £300 sterling each), such as the Epson Stylus Color range.[11] This will enable us to start sending colour pictures of the fundi with our reports of retinal screenings to primary care practitioners. For a fraction of the cost of Polaroid we will have high quality images stored on computer disk, and printed out for the primary care practitioner, the ophthalmologist, and the hospital notes. Electronic link-ups to the ophthalmologists (and eventually to primary care practitioners) will allow us to 'e-mail' the images for high quality viewing by the ophthalmologist on a computer at the time of referral. With the coming of a computer network for the National Health Service ('NHS net') and the rate of increase in computerization in the Health Service generally, it seems likely that it is only a matter of time before fully live, shared, clinical databases of diabetic patients between primary and secondary care are the norm. The current political movement away from the purchaser/provider split in the UK, should also facilitate the earlier introduction of such

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an obvious patient orientated step forward. Thus one can see a time when hospital diabetes specialists, ophthalmologists, and primary care doctors will all readily be able to view the same digital retinal images of their patients (along with all other clinical data) from the same clinical computer database, accessed via the NHS net, from wherever they do their clinics and surgeries.

Even at the present time imaging software is able to 'enhance' the image quality. As we move into the future, attempts are already being made to see if the images can be analysed and lesions identified using image analysis software or artificial neural networks entirely.[12,13] It may not be long into the 21st century when the computer will be able to do a complete, automatic, and highly accurate, analysis and report the degree of diabetic retinopathy, or not, on the digital retinal image, and give recommendations with regard to optimum further management.

Robert E.J. Ryder
Department of Diabetes and Endocrinology and Lipid Metabolism City Hospital NHS Trust, Birmingham B18 7QH, UK

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